

Covering teacher guide

Wave-speed, frequency and wavelength calculations

Start here / subject briefing

Before this lesson: Consolidation after pupils have met wave quantities, simple graphs and $v = f\lambda$. Pupils need a calculator; all data and figures are supplied. No demonstration or experiment is needed.

Wave speed is how fast the disturbance travels. Frequency counts cycles each second; wavelength is the distance per cycle, so multiplying them gives distance per second. Period is time per cycle and is the reciprocal of frequency. A distance snapshot gives wavelength; a time trace gives period. Amplitude is displacement from the undisturbed position, not wavelength or speed.

Words and symbols you will need

Term	Plain-English meaning
Wavelength, λ (lambda), m	Distance between adjacent matching points, such as crests. Four crests enclose three wavelength intervals.
Frequency, f , Hz	Complete cycles per second. Count cycles, then divide by elapsed seconds.
Period, T , s	Time for one complete cycle. $f = 1 / T$ and $T = 1 / f$.
Amplitude, m	Maximum displacement from the undisturbed position. Peak-to-trough height is twice amplitude.
Wave speed, v , m/s	Speed of the travelling disturbance, not the oscillating buoy/particle.

Help pupils choose a method

1. Identify the required quantity and read the axis quantity/unit before using a graph.
2. Convert centimetres to metres or milliseconds to seconds before substituting.
3. Choose $v = f\lambda$, $\lambda = v/f$ or $f = v/\lambda$. If given period, first use $f = 1/T$. Include units and check the product $f\lambda$.

Use the supplied model - pupil page 2

Use pupil page 2: 25 cycles each second, each 0.080 m long, gives 2.0 m each second. For the separate rearrangement, divide 2.0 m/s by 5.0 cycles/s to get 0.40 m per cycle, then multiply back to check.

First, $v = f \times \text{wavelength} = 25 \times 0.080 = 2.0 \text{ m/s}$. For the second test, $\text{wavelength} = v / f = 2.0 / 5.0 = 0.40 \text{ m}$. Check: $5.0 \times 0.40 = 2.0 \text{ m/s}$.

If pupils are still stuck

Use the matching Say/Ask/Expect coaching and named fresh retry in its replacement time. If still insecure, help the pupil label f , wavelength and units or set up the correct fraction, then record that exact difficulty for the usual teacher. Do not add an unscheduled practical.

Turn to teacher page 2 for the timed run sheet. Keep this guide separate from the pupil booklet.

Run the lesson from this page

Wave-speed, frequency and wavelength calculations

Print the complete 8-page pupil booklet in order, one per pupil. Staple each booklet; double-sided printing is fine.

Read the subject briefing on teacher page 1, then use the run sheet on page 2. Keep this guide separate from pupil copies.

Pupils need pens, a ruler and a calculator. All figures, context and reading are supplied; no login, devices or apparatus are needed.

Min	Pupil page / Q	Read aloud / check	Next action and answer key
0-5	1 / 1-3	Start from memory on page 1. At 5 minutes check the three responses.	If insecure, use Try again A in the first 2 reading minutes. Answers: teacher page 3. Coaching: page 7.
5-15	2 / reading	Read the quantity table, equations and both model calculations. Read each graph-axis rule.	Check A if used, then continue reading.
15-20	3 / 4	Choose a letter and show the conversion and division. Stop at check 2.	If insecure, Try again B replaces questions 5-6. Answers: teacher page 3. Coaching: page 8.
20-30	3-4 / 5-11	Complete the separate-test calculations, then use the harbour snapshot.	If B was used, leave 5-6 blank. Require SI units and wavelength intervals. Answers: teacher page 4.
30-33	5 / 12	Pause for the independent space-and-time check.	If insecure, Try again C replaces questions 13-14. Answers: teacher page 4. Coaching: page 9.
33-45	5-7 / 13-20	Continue with the harbour graphs, explanations and fixed-speed prediction.	If C was used, leave 13-14 blank. Both figures are repeated on page 6. Answers: teacher page 5.
45-55	8 / 21	Correct practice in a different colour; explain one correction.	Share only practice answers. Keep exit answers hidden. Answers: teacher page 5.
55-60	8 / 22	Cover earlier pages. Complete question 22 independently.	Collect every booklet and check afterwards. D is next lesson only. Answers: teacher page 6. Coaching: page 10.

Estimated 60 minutes. Practice is 10 minutes, a 3-minute check, then 12 minutes. A uses reading time; B replaces 5-6; C replaces 13-14; D is next lesson only. No early-finisher extra worksheet parts are assigned. Timings are not classroom-trialled.

Entry and hinge - pupil pages 1 and 3

Match the pupil number. Accept equivalent correct wording. Keep this guide separate from pupils.

1. (pupil p1) $45 / 100 = 0.45 \text{ m}$.

2. (pupil p1) $f = 12 / 3.0 = 4.0 \text{ Hz}$.

3. (pupil p1) Adjacent crest spacing is 5 m; it is a distance. The 10 m from first to last spans two wavelengths.

4. (pupil p3) B. $60 \text{ cm} = 0.60 \text{ m}$; $f = v / \text{wavelength} = 3.0 / 0.60 = 5.0 \text{ Hz}$.

Try again A - pupil page 1

Only if your teacher asks. Use the first 2 reading minutes, then continue on page 2.

(a) 0.35 m. (b) $18 / 6.0 = 3.0 \text{ Hz}$. (c) 4.0 m; the 8 m full span contains two intervals.

Try again B - pupil page 3

Only if your teacher asks. Complete this instead of questions 5-6, then continue with questions 7-11.

$50 \text{ cm} = 0.50 \text{ m}$; $f = 4.0 / 0.50 = 8.0 \text{ Hz}$. Check $8.0 \times 0.50 = 4.0 \text{ m/s}$.

First practice and mid-check - pupil pages 3-5

Match the pupil number. Accept equivalent correct wording. Keep this guide separate from pupils.

5. (pupil p3) $f = \text{number} / \text{time} = 30 / 75 = 0.40 \text{ Hz}$.

6. (pupil p3) $v = f \times \text{wavelength} = 0.40 \times 15 = 6.0 \text{ m/s}$.

7. (pupil p3) $\text{Wavelength} = v / f = 5.0 / 0.25 = 20 \text{ m}$.

8. (pupil p4) $f = v / \text{wavelength} = 18 / 0.60 = 30 \text{ Hz}$.

9. (pupil p4) $75 \text{ cm} / 100 = 0.75 \text{ m}$. $v = 24 \times 0.75 = 18 \text{ m/s}$.

10. (pupil p4) Amplitude = 0.40 m, from the undisturbed position to a crest. 0.80 m is peak-to-trough height.

11. (pupil p4) The four crests at 0, 24, 48 and 72 m enclose three complete wavelength intervals.
Wavelength = $72 / 3 = 24 \text{ m}$.

12. (pupil p5) Wavelength = 0.80 m; $T = 0.20 \text{ s}$. $f = 1 / 0.20 = 5.0 \text{ Hz}$; $v = 5.0 \times 0.80 = 4.0 \text{ m/s}$.

Try again C - pupil page 5

Only if your teacher asks. Complete this instead of questions 13-14, then continue with questions 15-20.

Wavelength = 0.60 m; $T = 0.30 \text{ s}$; $f = 1 / 0.30 = 3.33... \text{ Hz}$; $v = (1 / 0.30) \times 0.60 = 2.0 \text{ m/s}$. Accept 3.3 Hz and approximately 2.0 m/s; keep calculator precision when possible.

Later practice and review - pupil pages 5-8

Match the pupil number. Accept equivalent correct wording. Keep this guide separate from pupils.

13. (pupil p5) Height = $0.40 - (-0.40) = 0.80$ m, or twice amplitude. Yes: 0.80 m exceeds the supplied 0.70 m threshold.

14. (pupil p5) Four crests enclose three complete wavelength intervals, not four. Divide the 72 m span by three to obtain 24 m.

15. (pupil p6) $T = 4.0$ s, for example the time from the crest at 0 s to the crest at 4 s. Accept 4-8 s or 8-12 s. Crest-to-trough gives half a period.

16. (pupil p6) $f = 1 / T = 1 / 4.0 = 0.25$ Hz. Also accept three complete oscillations / 12 s.

17. (pupil p6) Wavelength = 24 m; period = 4.0 s, so $f = 0.25$ Hz. $v = 0.25 \times 24 = 6.0$ m/s. Accept wavelength / period = $24 / 4 = 6.0$ m/s.

18. (pupil p7) 6.0 m/s is the speed of the travelling wave/disturbance horizontally. The moored buoy oscillates vertically about its undisturbed position; its changing instantaneous speed is not this horizontal wave speed.

19. (pupil p7) Frequency is still $3 / 12 = 0.25$ Hz. Wavelength is still 24 m, so $v = 0.25 \times 24 = 6.0$ m/s. Halving amplitude alone has not halved wave speed in these data.

20. (pupil p7) New wavelength = $v / f = 6.0 / 0.50 = 12$ m. Frequency doubles while speed stays fixed, so wavelength halves. Check $0.50 \times 12 = 6.0$ m/s.

21. (pupil p8) Accept a corrected answer with its physical or mathematical reason, not a copied final value. All-correct route: intervals are the gaps between crests, so four consecutive crests enclose three complete wavelengths.

Exit and next-lesson follow-up - pupil page 8

Match the pupil number. Accept equivalent correct wording. Keep this guide separate from pupils.

22. (pupil p8) (a) $f = 15 / 3.0 = 5.0$ Hz. $40 \text{ cm} = 0.40 \text{ m}$; $v = 5.0 \times 0.40 = 2.0 \text{ m/s}$. (b) Period, in seconds. (c) Speed remains 2.0 m/s because f and wavelength are unchanged; amplitude is not a factor in $v = f \times \text{wavelength}$.

Try again D - next lesson - pupil page 8

Leave this today. Your usual teacher may ask you to do it next lesson.

$f = 24 / 4.0 = 6.0$ Hz; $30 \text{ cm} = 0.30 \text{ m}$; $v = 6.0 \times 0.30 = 1.8 \text{ m/s}$. The 0.50 s interval is period. Doubling amplitude with f and wavelength fixed leaves speed unchanged. The time trace is a separate example, not the first wave.

Collect and follow up

Collect all named booklets. Use the independent exit to record frequency calculation, SI conversion, wave-speed use, axis interpretation and amplitude reasoning. Tell the usual teacher the exact remaining error and who needs Try again D.

Source provenance - for the usual teacher

Pupil question	Original worksheet part / page
5	WS-11 Q1(b) / source p1
6	WS-11 Q1(c) / source p1
7	WS-11 Q1(d) / source p2
8	WS-11 Q1(e) / source p2
9	WS-11 Q1(f) / source p2
10	WS-11 Q2(a) / source p2
11	WS-11 Q2(b) / source p2
13	WS-11 Q2(c) / source p3
14	WS-11 Q2(d) / source p3
15	WS-11 Q3(a) / source p3
16	WS-11 Q3(b) / source p3
17	WS-11 Q3(c) / source p4
18	WS-11 Q3(d) / source p4
19	WS-11 Q3(e) / source p4

Selected practice is reformatted from the maintained PhysicsUK worksheet. Required context is included; unassigned parts are omitted.

Source worksheet | Maintained solutions | Revision notes

The first worked-model calculation uses the revision note section 1 Wave speed example; its rearrangement is original cover-lesson support. Reading selects sections 2, 3 and 5. Source Q3(f,g) is omitted to protect lesson time.

Check 1: Entry

Question 1, Question 2, Question 3

Look for: Question 1: 0.45 m; question 2: 4.0 Hz; question 3: 5 m, a distance.

If secure: Continue to the reading and model on pupil page 2.

If: 45 cm becomes 45 m or 4500 m, or question 2 uses time divided by count.

Likely issue: SI conversion or frequency per second is insecure.

Say: One metre contains 100 centimetres. Frequency counts complete oscillations in one second, so divide count by elapsed time.

Ask: For questions 1-2, what are 45 divided by 100 and 12 divided by 3?

Expect: 0.45 m and 4.0 Hz. Hertz means complete oscillations per second.

Next: Use the units/frequency table on page 2. Direct Try again A on page 1 in the first 2 reading minutes. Check all three fresh answers.

Pupil page 2, quantities and Convert first; Try again A on page 1.

If: Question 3 gives 10 m or a time unit.

Likely issue: The pupil uses the full span or confuses space with time.

Say: Wavelength is the distance from one crest to the next. Three crests enclose two intervals.

Ask: In question 3, how far is it from the crest at 2 m to the next crest at 7 m? What unit is on those coordinates?

Expect: 5 m, a distance. The 10 m total spans two wavelengths.

Next: Use page 2, wavelength and the horizontal-axis rule. Use Try again A in reading time.

Pupil page 2, Check the horizontal axis; Try again A on page 1.

If the retry remains insecure, use the support guidance on teacher page 1 and record the precise difficulty for the usual teacher.

Check 2: Hinge

Question 4

Look for: B, with $60 \text{ cm} = 0.60 \text{ m}$ and $f = 3.0 / 0.60 = 5.0 \text{ Hz}$. A letter alone is insufficient.

If secure: Start questions 5-11. Require conversion and an equation with substitution.

If: A uses 3 divided by 60.

Likely issue: Centimetres were used with speed in m/s.

Say: The speed uses metres, so the wavelength must also use metres before division.

Ask: In question 4, what is 60 cm in metres? Now divide 3.0 by that value.

Expect: 0.60 m ; $3.0 / 0.60 = 5.0 \text{ Hz}$, option B.

Next: Use page 2, Convert first, then Try again B on page 3 instead of questions 5-6.

Pupil page 2, Convert first; Try again B on page 3.

If: C multiplies speed and wavelength or D reverses the division.

Likely issue: Rearranging the wave equation is insecure.

Say: Start with $v = f \times \text{wavelength}$. To leave f alone, divide speed by wavelength. Check by multiplying your f by wavelength.

Ask: Which value multiplied by 0.60 m gives 3.0 m/s in question 4?

Expect: 5.0 Hz . $5.0 \times 0.60 = 3.0$, so $f = 3.0 / 0.60$.

Next: Use the rearrangement and model on page 2. Direct Try again B instead of questions 5-6.

Pupil page 2, rearrangements and worked model; Try again B on page 3.

If: B is chosen without a valid conversion and equation.

Likely issue: The correct letter may be a guess.

Say: A correct letter needs a checkable method: convert, choose the rearrangement, substitute and check.

Ask: Explain how the two supplied quantities in question 4 give your chosen frequency.

Expect: $60 \text{ cm} = 0.60 \text{ m}$; $f = 3.0 / 0.60 = 5.0 \text{ Hz}$. Multiplying by 0.60 recovers 3.0 m/s .

Next: Ask for conversion and substitution. If insecure, use Try again B instead of questions 5-6.

Pupil page 2, Convert first and $f = v / \lambda$; Try again B on page 3.

If the retry remains insecure, use the support guidance on teacher page 1 and record the precise difficulty for the usual teacher.

Check 3: Mid Practice

Question 12

Look for: Question 12: wavelength 0.80 m, period 0.20 s, frequency 5.0 Hz and speed 4.0 m/s.

If secure: Continue questions 13-20 using the axis rules, including both harbour figures.

If: Calls 0.20 s the wavelength or 0.80 m the period.

Likely issue: The graph shape has been used without its horizontal-axis quantity.

Say: A distance snapshot gives metres between crests: wavelength. A time trace gives seconds between cycles: period.

Ask: In question 12, which supplied interval is in metres, and which is in seconds?

Expect: 0.80 m is wavelength; 0.20 s is period.

Next: Use page 2, Check the horizontal axis. Complete Try again C on page 5 instead of questions 13-14, then continue 15-20.

Pupil page 2, axis rule; Try again C on page 5.

If: Multiplies 0.20 by 0.80, or treats the 0.20 s period as 0.20 Hz.

Likely issue: Period and frequency have been equated.

Say: Period is seconds per cycle. Frequency is cycles per second, so take its reciprocal before multiplying by wavelength.

Ask: In question 12, how many cycles fit in one second if each takes 0.20 s? What is 5.0×0.80 ?

Expect: 5.0 cycles per second = 5.0 Hz; speed = 4.0 m/s.

Next: Use $f = 1 / T$ on page 2 before the wave equation. Complete Try again C instead of questions 13-14.

Pupil page 2, frequency/period and wave equation; Try again C on page 5.

If the retry remains insecure, use the support guidance on teacher page 1 and record the precise difficulty for the usual teacher.

Check 4: Exit

Question 22

Look for: Question 22: 5.0 Hz, 0.40 m and 2.0 m/s; the time-trace spacing is period; doubled amplitude leaves speed unchanged.

If secure: Record which objectives are demonstrated independently and any exact follow-up needed.

If: Numerical work has an incorrect frequency, missing cm conversion or wrong wave-equation operation.

Likely issue: Count/time, conversion or equation use still needs support.

Say: Calculate cycles per second, convert the wavelength to metres, then multiply frequency by wavelength.

Ask: For question 22, what are $15 / 3$ and $40 / 100$? Which multiplication gives wave speed?

Expect: 5.0 Hz and 0.40 m; $5.0 \times 0.40 = 2.0$ m/s.

Next: Next lesson, revisit the quantity table and model on page 2, then direct Try again D independently on page 8.

Pupil page 2, quantities, conversion and wave equation; Try again D on page 8, next lesson.

If: Names the time spacing wavelength or says doubled amplitude doubles speed.

Likely issue: The axis meaning or dependence of wave speed remains insecure.

Say: A time axis measures seconds per cycle, or period. The wave equation uses frequency and wavelength; those are unchanged in this claim.

Ask: In question 22, which horizontal-axis unit identifies period? Which two factors set speed here?

Expect: Seconds identify period. Frequency and wavelength stay fixed, so speed remains 2.0 m/s.

Next: Next lesson, use the axis and fixed-speed rules on page 2 before Try again D. Keep this outside today's 60 minutes.

Pupil page 2, Check the horizontal axis and fixed-speed rule; Try again D on page 8, next lesson.

If the retry remains insecure, use the support guidance on teacher page 1 and record the precise difficulty for the usual teacher.

Specification and review

AQA 8463: 4.6.1.2 | AQA 8464: 6.6.1.2. Both courses and tiers: wave quantities, $v = f\lambda$ and rearrangements, SI conversion, period/frequency, graph axes and fixed-speed predictions. The buoy comparison clarifies the meaning of wave speed. Practical methods and Separate-only sound-boundary work are excluded.

PhysicsUK original cover lesson. Reviewed 2026-10-31. Timings estimated.